Minutes of Meeting 2 of SC-186 Working Group 3
Development of MOPS for 1090 MHz ADS-B, Revision A

The meeting was called to order by Dr Vince Orlando at 9am on 30 January 2001, at the Hilton Melbourne Beach Resort, hosted by Rockwell-Collins. Dr. Orlando welcomed all attendees, gave some introductory remarks, and asked that each attendee introduce themselves and their organization. The attendees included:

Cynthia Cyrus, Trios Assoc. (FAA Ctr)	Ian Levitt, Titan Corp. (FAA TC – ACT-350)	Stu Searight, FAA TC – ACT-350
Gary Furr, Titan Corp. (FAA TC - ACT-350)	James Maynard, UPS Aviation Tech.	Bob Semar, United Airlines
William Harman, MIT Lincoln Lab	Vince Orlando, MIT Lincoln Lab	John Van Dongen, FAA TC – ACT-350
Ron Jones, FAA – ASD-140	Stacey Rowlan, L3 Communications	Gene Wong, FAA – AND-530
Greg Kuehl, UPS Airlines	Bob Saffell, Rockwell Colins	

1. Following the introductions, the following known regrets to attendance were announced:

   Jerry Anderson, FAA AIR-130 had previously informed us that he would be unable to attend this meeting.

2. Vince Orlando informed the Working Group that the name and focus of the old SICASP has been changed to the Surveillance and Conflict Resolution Systems Panel (SCRSP) to reflect the focus and need within ICAO for Surveillance and Conflict Resolution. SCRSP will be made up of Working Group A for Conflict Resolution and Working Group B for Surveillance. Additionally, Document 9688 will be republished by the end of 2001 with all of the requirements removed and placed into the SARPS.

3. The Working Group began to address Agenda Item #4 (Report on Open Action Items) with the presentation of **Working Paper 2-01** by Ian Levitt, entitled "The Analysis of Coast Time Extension" in support of Action Item 1-2. The conclusion of Working Paper 2-01 was that the coast time could be changed from 25 seconds to 120 seconds. Follow-on discussion concerning CPR focused on Section A.7.8.2 (Range Monitoring Local Decoding) and Stacey Rowlan was assigned **Action Item 2-1** for the purpose of reviewing all of Section A.7 to compare the CPR Equations for consistency.

4. Working Paper 2-03 was then reviewed by Vince Orlando and Gary Furr with regard to changes made to Figures 2-16b and 2-16c, and in Sections 2.2.10.3 and 2.4.10.3, to account for the proposed change in coast time for a Global Decode from 25 to 120 seconds. All changes identified in Working Paper 2-03 were accepted. However, **Action Item 2-2** was assigned to Bill Harman for reviewing Figure 2-16a and making any recommendation on changes necessary as a result of the coast time changes.

5. Working Paper 2-05 was reviewed by Jim Maynard as a recommendation for change to the values in the last row of Table 2-90. Changes recommended by Randy Jacobson of UPS Aviation Technologies in WP-2-05 were discussed at length, and a separate group consisting of Ian Levitt, Bill Harman and Jim Maynard reviewed this proposed change versus the original published numbers in Table 2-90, and the modification to the same last row as proposed by Ian Levitt in Meeting #1. The LAT_low input in the final row of Table 2-90 should be the AWB nearest to 87 degrees. This latitude, when entered into the CPR algorithm, will access the NL table with the value of *precisely* 87 degrees, and test that the implementation chooses 2 for the number of longitude divisions. Because the AWB value nearest to 87 degrees is greater than 87 degrees, to clear up any confusion, the value in the last row of Table 2-90 is the AWB value just less than 87 degrees. This makes no practical

impact to the test whatsoever. After further Working Group discussion, it was agreed that the last row of Table 2-90 would be:

86.999999	3DDDDDDD	87.000011	3DDDDE66	00000	00000	00001	10000

6. Working Paper 2-07 was reviewed by Gary Furr as proposed additions of HEX AWB values to Tables 2-89, 2-90 and 2-91. WG-3 reviewed and discussed the proposed additions and all additions were accepted. Copies of the new Tables 2-89, 2-90 and 2-91 will be posted on the 1090 MHz MOPS WG-3 web site at http://adsb.tc.faa.gov as accepted changes to DO-260, going forward.

7. In response to Action Item 1-10, Vince Orlando presented Working Paper 2-04 in order to meet MASPS track acquisition requirements for long range deconfliction. The requirements for this additional squitter is included in Appendix A.4.12, but was inadvertently omitted from Section 2.2.3.3.2.4. Working Paper 2-04 presented the changes proposed to Section 2.2.3.3.2.4. The Working Group accepted the proposed changes and assigned **Action Item 2-3** to Bob Saffell to review Section 2.4.3.3.2.4 for necessary changes consistent with the accepted changes to Section 2.2.3.3.2.4. A copy of Section 2.2.3.3.2.4 will be posted on the 1090 MHz MOPS WG-3 web site at http://adsb.tc.faa.gov as accepted changes to DO-260, going forward.

8. In response to Action Item 1-8, Ron Jones presented Working Paper 2-08 as his case for creating a new Appendix for DO-260A to address techniques, not addressed in the main body of DO-260, that would provide improvements in 1090 extended squitter reception in terms of air-to-air range that would be applicable to the most capable class of user. As a reward for his success, Ron Jones was assigned **Action Item 2-4** to begin an outline of a new Appendix "M" for DO-260A to address techniques for improved reception range.

9. At the June 2000 SC-186 Plenary which reviewed the final draft of the 1090 MOPS, Bob Hilb requested a change be made to the CC_4 Subfield of the Aircraft Operational Status Message. Upon review of this change after the Plenary and prior to publication of DO-260, WG-3 members made modifications to the Plenary-agreed text of the CC_4 Subfield. Upon review of these changes during the 1ˢᵗ Meeting of WG-3, there were further changes agreed to. Working Paper 2-12 was presented by Gary Furr as the changes to Table 2-54, Table A-13 and Section 2.4.3.2.7.3.3.1 as a result of the agreed changes during WG-3 Meeting #1. Upon review and discussion of the changes presented in WP-2-12, WG-3 agreed to again modify Tables 2-54 and A-13 by moving the encoding meanings down to begin at the Bit 9 coding of 0100, instead of as presented beginning at coding 0000. This change as deemed necessary in order to avoid conflict with potential systems developed using the published version of DO-260. A copy of the 'finally agreed-to' versions of Table 2-54, Table A-13 and Section 2.4.3.2.7.3.3.1 will be posted on the 1090 MHz MOPS WG-3 web site at http://adsb.tc.faa.gov as accepted changes to DO-260, going forward.

Further discussion regarding changes to DO-260 led to the proposal of a "Version" field being made available in the Status Message. **Action Item 2-5** was assigned to Vince Orlando to present a proposal for a "Version Field in the Status Message.

10. Greg Kuehl presented Working Paper 2-13, which proposes changes/additions to Section 3.5 because of changes to the TCAS and CDTI status bits discussed above in Tables 2-54, A-13 and Section 2.2.3.2.7.3.3.1. Following discussion of Working Paper 2-13, Vince Orlando accepted **Action Item 2-6** to draft a TCAS active resolution advisory broadcast for 1090 MHz.

11. Vince Orlando presented Working Paper 2-09 in response to Action Item 1-6 as a proposal for changes/additions to Appendix I. At WG-3 Meeting 1, it was noted that Appendix I covered a number of topics but did not define the configuration used as the basis for the MOPS requirements for enhanced squitter reception. Working Paper 2-09 proposed changes to Appendix I to address this concern. Following discussion, the Working Group accepted these changes. Changes will be made to Appendix I based on WP-2-09, and Appendix I will be posted on the 1090 MHz MOPS WG-3 web site at http://adsb.tc.faa.gov as accepted changes to DO-260, going forward.

12. John Van Dongen presented Working Paper 2-15, describing the software description of the 1090 MHz Radio Frequency Measurement (RMF) Enhanced Reception Technique Implementation. The Working Group discussed many aspects of the "Gold Standard" and the differences between the implementations of the FAA Technical Center, as presented by John Van Dongen, and the MIT Lincoln Labs as discussed by Bill Harman and Vince Orlando.

13. The Working Group proceeded to review the comments to Appendix I as presented by John Van Dongen in Working Paper 2-11. Comments 1 and 2 were accepted as purely editorial to be implemented by Gary Furr. Disposition of each of the remaining comments are as described in the "Disposition" column of WP-2-11 as posted on the 1090 MHz MOPS WG-3 web site at http://adsb.tc.faa.gov . Changes will be made to Appendix I based on WP-2-11, and Appendix I will be posted on the 1090 MHz MOPS WG-3 web site at http://adsb.tc.faa.gov as accepted changes to DO-260, going forward. **Action Items 2-11** and **2-12** were assigned as a result of discussions on Appendix I and WP-2-11.

14. Following the discussion of Comment #12 on Working Paper 2-11, John Van Dongen presented Working Paper 2-14, which was a data analysis of Table I-1 in Appendix I, Combining Odd and Even Outputs. As a result of discussion on this topic, **Action Item 2-13** was assigned to John Van Dongen to analyze data from WP-2-14 to consider reply reception probability for the alternate matrix if conservative is the only error correction technique applied.

15. Working Paper 2-16 was presented by Stacey Rowlan of L-3 Communications. Appendix I discusses the following Enhanced Squitter Detection Techniques: Preamble Detection, Bit Value and Confidence Declaration, and Error Correction. Working Paper 2-16 makes a case for each category of enhancement being tested independently. This is to ensure that each of the enhancements are correctly implemented.   While each enhancement will provide improved reply reception in environments where interference is present, each enhancement is unique in what type of interference environment it is most effective in improving reply function.

16. Following discussion on Working Paper 2-16, graphs representing Extended Squitter Bench Tests showing the behavior of reception probability when there are interferers at different power levels versus the performance with the interferers at the same power level, were presented by Bill Harman and given the identification of Working Paper 2-17. The results indicated that the testing with the same power levels was a valid (and simpler) approach. An electronic copy of this presentation will be provided by Bill Harman and posted on the 1090 MHz MOPS WG-3 web site at http://adsb.tc.faa.gov .

17. Jim Maynard presented a review of Working Paper 2-02, which was his proposal for 1090 MHz TIS-B Message Formats, in support of Action Item 1-9. The Working Group agreed to accept the proposed formats as presented in WP-2-02 until further change becomes necessary.

18. In conjunction with discussion on 1090 MHz TIS-B, Working Paper 2-10 was presented by Vince Orlando, as a proposal for the requirement for and the use of Service Volume ID (SVID) in TIS-B.

Action Item 2-16 was assigned to Jim Maynard to draft a candidate SVID Management Message for service volume coverage.

19. Working Paper 2-06 was presented by Vince Orlando showing how FIS-B could be supported on 1090 MHz. It included message coding and estimates of channel activity needed to support an assumed level of FIS-B services. This briefing was originally prepared by Jonathan Bernays of MIT Lincoln Laboratory for presentation to the Technical Link Assessment Team (TLAT).

20. The following **Action Items** were identified at this, or previous, meetings of this Working Group. The asterisk (*) beside a name or organization indicates that they are the lead for the resolution of that Action Item.

Action Number	Action Description	Assigned to	Status
1-1	Review the test procedures in DO-181B and DO-260 with respect to "FS" and "VS" and make a recommendation for changes to either document.	Tom Pagano	01/30/01 – Will be deferred to later meeting
1-2	Propose technical support for a change to the condition for performing a new global decode to change from 25 seconds to 120 seconds.	Vince Orlando	Addressed by WP-2-01 and WP-2-03, Mtg 2 **CLOSED**
1-3	Add values for Hex AWB for values in Tables 2-89, 2-90 and 2-91.	Ian Levitt	Addressed by WP-2-07, Mtg 2 **CLOSED**
1-4	Examine APL data on Extended Squitter Bench Tests to show that testing with the same power levels for multiple ATCRBS interferers is an adequate test.	Harman/Pagano	Data presented at Mtg 2 **CLOSED**
1-5	Describe how the different enhancements are tested in different ways, with a different set of characteristics.	Stacey Rowlan	Addressed by WP-2-16, Mtg 2 **CLOSED**
1-6	Revisit Appendix I	Orlando/Harman	Addressed by WP-2-09, Mtg 2 **CLOSED**
1-7	Compare performance of their non real-time test sets.	MIT/FAATC	Deferred to later meeting
1-8	Consideration on an additional Appendix to identify other methods of achieving enhanced reception.	Ron Jones	Addressed by WP-2-08, Mtg 2 **CLOSED**
1-9	Revise TIS-B formats to include comments from 1090 meeting 11/29/00	Vince Orlando	Addressed by WP-2-02, and WP-2-10 Mtg 2 **CLOSED**
1-10	Provide an update to Section 2.2.3.3.2.4 in support of additional ID and Type squitter every 5 seconds in conjunction with long range de-confliction application. This was identified in Appendix A.4.12 of DO-260, but was never ported into Section 2.2 prior to publication.	Vince Orlando	Addressed by WP-2-04, Mtg 2 **CLOSED**

Action Number	Action Description	Assigned to	Status
2-1	Reviewing section A.7.8 and compare to equations agreed to by the Ad Hoc CPR Committee prior to the publication of DO-260	Stacey Rowlan	
2-2	Review Figure 2-16a to compare with changes made to Figures 2-16b and 2-16c	Bill Harman	
2-3	Review changes to 2.2.3.3.2.4 identified in WP-2-04 for needed changes to 2.4.3.3.2.4	Bob Saffell	
2-4	Begin outline of a new Appendix (M) for DO-260 to address techniques for improved reception range.	Ron Jones	
2-5	Propose a MOPS version field in the status message	Vince Orlando	
2-6	Draft a TCAS active resolution advisory broadcast for 1090 MHz.	Vince Orlando	
2-7	Discuss with Bob Hilb the reason for the active resolution broadcast.	Greg Kuehl	
2-8	Revisit WP-2-13 and expand with explanatory text. Get all text to Gary Furr for rolling into a proposed change to DO-260	Greg Kuehl (*) Gary Furr	
2-9	How do you implement the Brute Force technique?	Stacey Rowlan (*) Bob Saffell	
2-10	Resolve the conservative error correction relative to all combinations of flipping of low confidence bits and not just the first successful event.	Ian Levitt / MIT	
2-11	Verify that change made to comment #10 of WP-2-11 is correct.	Vince Orlando	
2-12	Add material to Appendix I to describe the technique for developing multisampling matrices for sampling rates higher than 8MHz	John Van Dongen	
2-13	Analyze data from WP-2-14 to consider reply reception probability for the alternate matrix if conservative is the only error correction technique applied.	John Van Dongen	
2-14	Develop a representative test of the enhanced processing techniques.	Vince Orlando	
2-15	Extended Squitter Bench Test specifications. Compute averages of bench test data.	Bill Harman	
2-16	Draft a candidate SVID Management Message for service volume coverage.	Jim Maynard	
2-17	Review the NL equation at A.7.2.d and possibly reword for latitudes at 87 degrees.	Jim Maynard	

21. The following **Working Papers** were identified during the course of this, or previous meetings of this Working Group. These papers as well as the Meeting Agendas and Meeting Minutes will be posted on the ADS-B 1090 MHz web site located at: http://adsb.tc.faa.gov

SC-186 Working Group 3 – 1090 MOPS, Rev A – Working Papers

Working Paper	Size	Description	Introduced At:

Working Paper	Size	Description	Introduced At:
SC186/WG3-WP-1-01	679KB	Extended Squitter Update presentation by Vince Orlando	Meeting 1, 11/28/00 MIT-LL Liaison – DC
SC186/WG3-WP-1-02	10KB	Issues remaining open from the Completion of DO-260 presented by Gary Furr	Meeting 1, 11/28/00 MIT-LL Liaison – DC
SC186/WG3-WP-1-03	19KB	Presentation on 1090 Support for TIS-B	Meeting 1, 11/28/00 MIT-LL Liaison – DC
SC186/WG3-WP-1-04	29KB	Rough Drafts of TIS-B 1090 MHz message formats presented by Vince Orlando	Meeting 1, 11/28/00 MIT-LL Liaison – DC
SC186/WG3-WP-1-05	53KB	MASPS Issues unresolved from DO-260 review at the June 2000 Plenary presented by Gary Furr	Meeting 1, 11/28/00 MIT-LL Liaison – DC
SC186/WG3-WP-1-06	8KB	Issues/Considerations for an Extended Squitter Enhanced Reception Performance MOPS as presented by Vince Orlando	Meeting 1, 11/28/00 MIT-LL Liaison – DC
SC186/WG3-WP-2-01	35KB	Analysis on allowing 120 second delay between Local CPR Decodes, presented by Ian Levitt in support of Action Item 1-2	Meeting 2, 01/30/01 Melbourne, FL
SC186/WG3-WP-2-02	58KB	1090 TIS-B Message Formats, presented by James Maynard as an update to WP-1-04, in support of Action Item 1-9	Meeting 2, 01/30/01 Melbourne, FL
SC186/WG3-WP-2-03	192KB	Extension of Coast Time for Global Decode from 25 to 120 seconds, presented by Vince Orlando in support of Action Item 1-2 with suggested changes to Sections 2.2.10.3 and 2.4.10.3, and Figures 2-16B and 2-16C.	Meeting 2, 01/30/01 Melbourne, FL
SC186/WG3-WP-2-04	152KB	Proposal to correct Section 2.2.3.3.2.4 to be consistent with A.4.12 as published in DO-260, presented by Vince Orlando in support of Action Item 1-10	Meeting 2, 01/30/01 Melbourne, FL
SC186/WG3-WP-2-05	11KB	Discussion of the modification of the last line of Table 2-90, presented by James Maynard on behalf of Randy Jacobson	Meeting 2, 01/30/01 Melbourne, FL
SC186/WG3-WP-2-06	546KB	Flight Information Services, Broadcast (FIS-B) on 1090 MHz, presented by Vince Orlando	Meeting 2, 01/30/01 Melbourne, FL
SC186/WG3-WP-2-07	103KB	Add values for Hex AWB for values in Tables 2-89, 2-90 & 2-91, presented by Ian Levitt in support of Action Item 1-3	Meeting 2, 01/30/01 Melbourne, FL
SC186/WG3-WP-2-08	13KB	Proposal to Develop an ADS-B 1090 MOPS Appendix on Techniques for Improved Reception Range, presented by Ron Jones in support of Action Item 1-8	Meeting 2, 01/30/01 Melbourne, FL
SC186/WG3-WP-2-09	15KB	Proposal for changes to Appendix I, presented by Vince Orlando in support of Action Item 1-6.	Meeting 2, 01/30/01 Melbourne, FL
SC186/WG3-WP-2-10	19KB	A discussion paper on the use of Service Volume ID (SVID) in TIS-B on 1090 MHz, presented by Vince Orlando.	Meeting 2, 01/30/01 Melbourne, FL
SC186/WG3-WP-2-11	13KB	Comments on Appendix I, DO-260 submitted by John Van Dongen, FAA Technical Center, ACT-350	Meeting 2, 01/30/01 Melbourne, FL

Working Paper	Size	Description	Introduced At:
SC186/WG3-WP-2-12	153KB	Review of Proposed Changes to the CC_4 Subfield of the Aircraft Operational Status Message, presented by Gary Furr	Meeting 2, 01/30/01 Melbourne, FL
SC186/WG3-WP-2-13	22KB	Suggested Changes to DO-260, Section 3.5, presented by Greg Kuehl, UPS Airlines	Meeting 2, 01/30/01 Melbourne, FL
SC186/WG3-WP-2-14	19KB	Data Analysis of Appendix I, Table I-1, Combining Odd and Even Outputs, prepared by John Van Dongen, FAA Technical Center, ACT-350	Meeting 2, 01/30/01 Melbourne, FL
SC186/WG3-WP-2-15	31KB	1090 Radio Frequency Measurement Facility (RMF) Enhanced Reception Technique Implementation, Software Description, prepared by John Van Dongen, FAA Technical Center, ACT-350	Meeting 2, 01/30/01 Melbourne, FL
SC186/WG3-WP-2-16	23KB	Considerations for Testing Enhanced Squitter Detection Techniques, presented by Stacey Rowlan in support of Action Item 1-5	Meeting 2, 01/30/01 Melbourne, FL
SC186/WG3-WP-2-17	35KB	Presentation of graphs showing results of Extended Squitter Bench Tests performed by APL on an LDPU, presented by Bill Harman, MIT Lincoln Labs	Meeting 2, 01/30/01 Melbourne, FL

22. The following table indicates the agreed upon meeting dates and places for proposed future meetings of Working Group #3 for the production of Revision A of the 1090 MHz MOPS (RTCA/DO-260A).

Dates/Time	Meeting Place
Tuesday, March 20 at 9am through 5pm Thursday, March 22	Confirmed at Phoenix Arizona hosted by L-3 Communications **Embassy Suites, 2577 West Greenway Rd., (602) 375-1777** Mention attendance at the "Honeywell" Meeting – rate = $89.00/night
Tuesday, May 15 at 9am through 5pm, Thursday, May 17	Confirmed at MIT/Lincoln Labs Aviation Liaison Office The Portals Building 1280 Maryland Ave., SW, Suite 250, Washington, DC (202) 646-0400
Tuesday, July 10 at 9am through 5pm Thursday, July 12	Confirmed at FAA Technical Center, Atlantic City International Airport (Secure facility, prior registration is required.) Call Gary Furr 609-485-4254 to verify attendance
Tuesday, August 21 at 9am through 5pm, Thursday, Aug 23	Meeting location TBD